MODEL 4105 SERIES

GAS SENSOR MODULE
WITH DIGITAL DISPLAY AND
NON-INTRUSIVE CALIBRATION

4-20 mA

sierra monitor corporation

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APPLICABILITY & EFFECTIVITY

This manual provides instructions for the following Sierra Monitor products:

Model	Description
4105-02	Combustible Gas Sensor Module with Non-Intrusive Calibration
4105-03	Oxygen Gas Sensor Module with Non-Intrusive Calibration
4105-04	Carbon Monioxide Gas Sensor Module with Non-Intrusive Calibration
4105-05	Hydrogen Sulfide Gas Sensor Module with Non-Intrusive Calibration
4105-06	Chlorine Gas Sensor Module with Non-Intrusive Calibration
4105-07	Hydrogen Gas Sensor Module with Non-Intrusive Calibration
4105-10	Sulfur Dioxide GasSensor Module with Non-Intrusive Calibration
4105-12	Nitrogen Dioxide Gas Sensor Module with Non-Intrusive Calibration
4105-21	Hydrogen Chloride Gas Sensor Module with Non-Intrusive Calibration
4105-22	Hydrogen Cyanide Gas Sensor Module with Non-Intrusive Calibration
4105-25	Ammonia Gas Sensor Module with Non-Intrusive Calibration
4105-26	Hydrogen Flouride Gas Sensor Module with Non-Intrusive Calibration

The instructions are effective for the above models as of April 1, 1998

Instruction Manual Part Number T13008
Rev. E1

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1. PRODUCT DESCRIPTION

1.1 Introduction

Model 4105 Series Gas Sensor module features non-intrusive calibration, 4-20 mA output signal and local continuous display of the gas concentration in ppm (toxics), % LEL (Combustibles), or % vol (Oxygen). It is designed for use with industry standard control instruments.

This manual provides instructions for 4105 series gas sensor modules that utilize common packaging and transmitter electronics with different sensors for detection of various gases. The full model number of the gas sensor module includes a suffix, 4105-XX, where "XX" is a number that identifies a gas type.

1.2 Application

The Model 4105-XX Gas sensor is intended for use in ambient monitoring applications. It is designed for fixed installation and for continuous operation.

Optional fittings and adapters can be supplied by Sierra Monitor to provide continuous sample delivery to the sensor module.

1.3 Configuration

The gas monitor is comprised of a NEMA-7/4 enclosure which contains the transmitter electronics and a gas sensor which is installed in one of the two 3/4" conduit hubs.

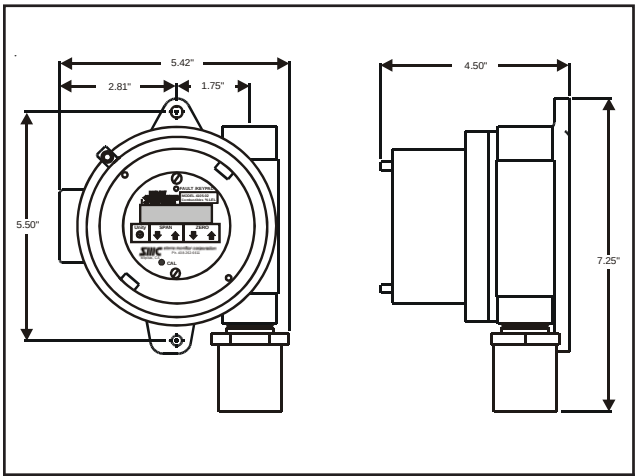


Figure 1.2 Outline View - Gas Sensor Module

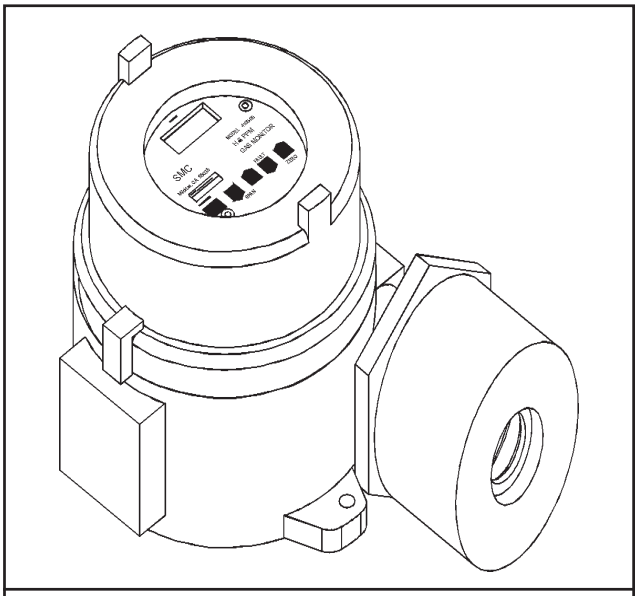


Figure 1.1 Model 4105 Gas Sensor Module

1.3.1 Electronics

When installed, the transmitter electronics will be connected to a power supply and control device via three wire cable.

The electronics provide a 4-20 mA current loop which is proportional to the full sensitivity of the sensor. Integral features include:

- L.C.D. readout of ppm of gas concentration.
- Magnetic switches for non-intrusive calibration.
- Visual indicators for fault condition.
- Electrical fault (0 mA) to controller.

The transmitter electronics assembly includes a printed circuit assembly and a cover plate which contains the L.C.D. readout and magnetic switches for calibration.

1.3.2 Sensor

The gas sensor cell is enclosed in a threaded housing and is plugged into a signal card located in the enclosure. This configuration allows for easy field replacement of the sensor cell.

Combustible: The gas sensor is a catalytic bead type.

Toxics & Oxygen: The gas sensor is an Electro Chemical type.

2. CAUTIONS WARNINGS & RECOMMENDATIONS

2.1 INTRODUCTION

Although the sensor module is designed and constructed for installation and operation in industrial applications including "hostile" environments, caution should be taken to insure that the installation is in compliance with this instruction manual and that certain procedures and conditions are avoided.

READ AND UNDERSTAND THIS INSTRUCTION MANUAL BEFORE OPERATING OR SERVICING THIS EQUIPMENT.

2.2 WIRING

Electro magnetic and radio frequency interference to the analog communication between the sensor and the controller may occur. The manufacturer recommends that extra caution be taken where the installation is near any sources of these interferences:

Avoid running sensor cable close to high power cables, radio transmission lines, or cables subject to pulses of high current. Avoid running cables near large electric motors or generators.

Use shielded cable in any location which may be expected to be electrically noisy or where cable is expected to be in close contact with AC wiring. The shield should be connected to the controller common, one side only.

The wiring should be run in either a cable tray or conduit as required by applicable code and area classification. Control wiring should not be installed in a cable tray or conduit with higher voltage and AC circuits. See Table 2.1 for recommended wire gauge.

Wiring connections at the gas sensor module are as follows:

Wire#	Function	Terminal
1	Power	PWR
2	Signal	SIG OUT
3	Ground	GND

Connect an earth ground to the ground screw provided in the base of the gas sensor module enclosure.

All splices must be via either a lug and terminal system or soldered. Improperly spliced cable can result in corrosion, resistance changes and system errors.

Wire Gauge	Maximum Length
20 AWG	2,000 Ft.
18 AWG	3,000 Ft.
16 AWG	4,000 Ft.
14 AWG	6,500 Ft.
12 AWG	9,000 Ft.

Table 2.1
Recommended Wire/Cable Gauge

NOTE: Temperature rating of cable wire insulation must be above 75^{O}C (85^{O}C or greater rated wiring is recommended). If cable runs through higher temperature environments, it should be specified for that environment.

2.3 SENSOR MODULES - GENERAL

Sensors should be facing down. Avoid installing sensor modules where they will be unnecessarily exposed to wind, dust, water (esp. direct hose down), shock, or vibration. Observe temperature range limitations.

Sensors may be adversely affected by prolonged exposure to certain materials. Loss of sensitivity, or corrosion, may be gradual if such materials are present in low concentrations. These materials include: Halides (compounds containing chlorine, fluorine, bromine, or iodine), silicones, acid vapors, caustic liquids or vapors.

Sensor modules must not be painted. Paint may contain compounds which will contaminate the sensor. Paint will also cause clogging of the sintered metal cup and will cause difficulties during attachment of the calibration fitiing. The module should be tagged "DO NOT PAINT".

When sensors are replaced the thread on the sensor housing **must be lubricated with an antizieze compound non-silicone based** to avoid metal to metal binding which will damage the housing threads.

2.4 PREVENTATIVE MAINTENANCE

DUST AND DIRT CONTROL: When calibration is performed the controller and sensors should be checked visually to determine if dust or dirt build up needs to be removed. This cleaning should be done with dry instruments such as compressed air, cloth wipes or wisk broom.

WIRING OR CABLE CONDITIONS: Any wiring or cables which are not in conduit should be checked once a year for damage to insulation or corrosion of splice or terminal points.

3. QUICK START

3.1 Overview

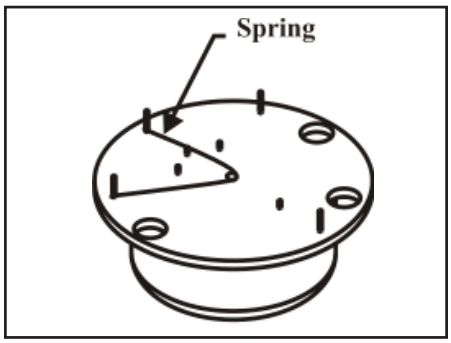
The gas sensor module has been supplied factory calibrated and ready for immediate installation and operation. An installer familiar with installation and operation of gas detection products can use this section to begin immediate use of the monitor.

3.2 Wiring

Provide three conductor wiring from the power supply/control device to the sensor module location. See section 2.2 for wiring specifications.

3.3 Module Installation

Remove spring on electromechanical sensor prior to installation. See Figure below.



The module can either be installed on the end of a 3/4" conduit, or attached to a vertical surface using the mounting flange on the enclosure.

WARNING:

- **The installation must meet any hazardous environment codes for electrical equipment.**
- **The sensor module enclosure mounting must be far enough from any vertical surface to allow removal and replacement of the sensor assembly which is threaded into the second 3/4" conduit hub.**

3.4 Wiring Connection

To gain access to the I/O PCB for wiring or mounting purposes, loosen the two captive thumb screws in the 4105-XX front panel and remove the PANEL/CPU PCB assembly as far as is allowed by the ribbon cable.

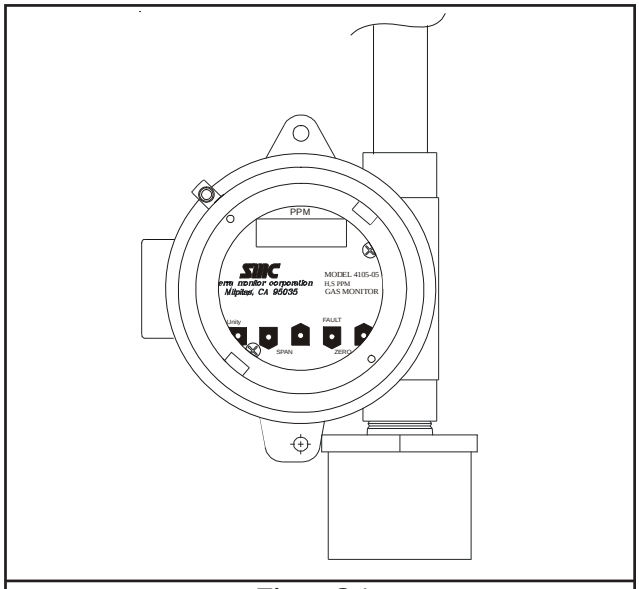


Figure 3.1
Typical Vertical Mounting on Conduit

Terminal positions on the I/O printed circuit assembly are labeled PWR (power), OUTSIG (signal), GND (TB2). Make the corresponding connections to the control device/power supply.

The sensor harness should remain connected to the I/O assembly at “TB1”.

3.5 Transmitter Installation

To install the front panel assembly, align the two thumb screws with their mating stand-offs and firmly hand tighten. Be sure the front panel is centered in the 4105-XX housing opening.

WARNING:

- **If the sensor transmitter is installed in a classified hazardous area, replace the threaded cover prior to providing power.**

3.6 Start-up & Operation

To begin operation of the sensor module provide 21-30 VDC from a regulated power supply.

4. OPERATION

4.1 Introduction

Under normal conditions the sensor module does not require operator or technician intervention. The following are conditions under which the module requires attention:

- **Routine periodic calibration.**
- **Calibration after a high gas alarm.**
- **Sensor replacement on a planned schedule or when a sensor failure occurs.**
- **Periodic cleaning as necessary.**
- **Unanticipated maintenance.**

4.2 Signal Value

During normal operation the current loop of the sensor module and the controller will be between 4 mA indicating no presence of gas, and 20 mA indicating that the full scale concentration of gas is present. The signal value is proportional to the concentration of gas present.

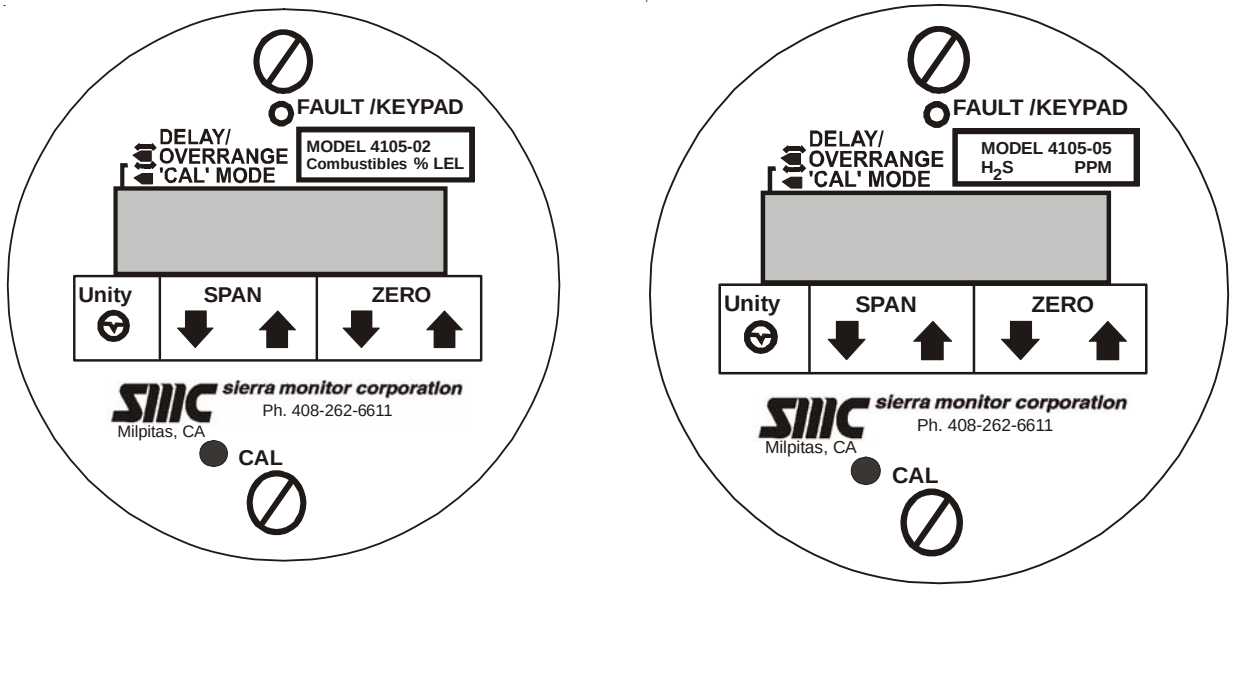


Figure 4.1
Transmitter Cover Plate

5. CALIBRATION

5.1 Frequency of Calibration

The manufacturer recommends that the gas sensor module be calibrated every ninety days.

5.2 Calibration Process

The output signal of the gas sensor module is calibrated using a span mixture containing a known concentration of the gas of interest. The concentration of the span gas must be within the full scale of the sensor module and should be either 50% of the full scale, or approximately equal to the lowest alarm level.

Calibration requires application of the span gas to the sensor and adjustment of the "SPAN" magnetic switch making the module signal output and display equivalent to the concentration of sample gas. The 4-20 mA output is held at 1.5 mA while activated for calibration to prevent alarms being tripped by calibration gas application.

5.3 Equipment Required

The following tools and equipment will be required for calibration:

- Magnetic tool
- Gas Sensor Calibrator, Model 1260-XX or Model 1200-26 or permeation tube
- Calibration Gas
- Disbursing Calibration Adapter (Model 5358-01)

5.4 Calibration Procedure

Routine calibrations are easily performed using the magnetic tool provided with each sensor.

Briefly hold the magnet tool close to the small dot located on the lower edge of the front panel. The arrow on the upper left side of the LED will illuminate and the 4-20 mA output is locked at 1.5 mA, indicating that the sensor module is ready for calibration. Simply expose the sensor to a ZERO gas and observe the L.C.D. readout. In normal situations, simply exposing the sensor to an atmosphere free of the gas of interest is satisfactory. If it does not return to the correct ZERO reading, a ZERO adjustment is required. Hold the magnet close to the UP ZERO or DOWN ZERO indicators and adjust the reading to the correct ZERO reading.

Connect the calibration adapter and expose the sensor to an appropriate SPAN gas using a span mixture containing a known concentration of the gas of interest at a minimum flow rate of 300 cc/minute. (Use permeation tube for 4105-25) Allow 3-5 minutes before making any adjustments.

If the L.C.D. does not display the correct SPAN value, a SPAN adjustment is required. With the arrow still flashing, hold the magnet close to the UP SPAN or DOWN-SPAN indicators and adjust the reading to the correct SPAN value. (The 4-20 mA out is automatically adjusted.)

The monitor is now calibrated. Deactivate calibration by holding the magnet close to the small dot again. This releases the 1.5 mA lock.

5.5 Fault Identification

A Fault condition is detected if the sensor output drifts far enough negative to cause the 4-20 mA output to reach 1.5 mA (±15% of full scale) or the sensor failure. The sensor module demonstrates that a fault condition exists by illuminating the RED LED on the front panel and by holding the 4-20 mA output at 0 mA. These conditions will exist until the fault is corrected.

Model	Gas	Min. Flow Rate (cc/min)
4105-02	CH_4	100
4105-03	O_2	100
4105-04	CO	150
4105-05	H_2S	300
4105-06	Cl_2	300
4105-07	H_2	300
4105-10	SO_2	300
4105-12	NO_2	300
4105-21	HCl	300
4105-22	HCN*	300
4105-25**	NH_3	400
4105-26	HF	500

*Note: SO_2 may be used instead of HCN to calibrate: 10ppm SO_2 = 16 ppm HCN
*Note: H_2S may be used instead of HCl to calibrate: 10 ppm H_2S = 20 ppm HCl
** Note: Use permeation tube for 4105-25

Table 4.1
Calibration Span Gas Flow Rates

6. SERVICE

6.1 Sensor Module Configuration

The gas sensor module is comprised of the following sub assemblies:

4105-XX Gas Sensor Module
- -SPM25002 Transmitter Assembly
- -SPT25013 Combustible Gas Sensor Module Transmitter Assembly
- -SPM25003 Oxygen and Toxic Gas Sensor Module Transmitter Assemby (must specify gas type)
- -4205-XX Sensor Assembly

[Where "xx" is the suffix to the gas sensor module number (Table 6.1)]

There is no field servicable components below the sub assembly level.

Warning: Prior to removal of the transmitter assembly, remove system power at the controller or other power source.

Model	Gas Module
4105-02	Combustible
4105-03	Oxygen
4105-04	CO
4105-05	H_2S
4105-06	Cl_2
4105-07	H_2
4105-10	SO_2
4105-12	NO_2
4105-21	HCl
4105-22	HCN
4105-25	NH_3
4105-26	HF

Table 6.1
Model Numbers

6.2 Enclosure Replacement

The enclosure should be replaced if the lid threads or conduit threads have been damaged, or if the enclosure has corroded sufficiently that it no longer meets the required NEMA classification.

To replace the enclosure follow the transmitter and sensor assembly removal instructions, remove the damaged enclosure from it's conduit or wall mounting, install a new enclosure and continue the transmitter and sensor assembly replacement instructions.

6.3 Transmitter Replacement

The transmitter assembly should be replaced when it is determined that it is unreliable, noisy or cannot be adjusted for calibration. This may occur due to age, corrosion or failed components.

To replace the transmitter assembly:

1. Remove the cover of the main enclosure.
2. Remove the front panel by loosening the two captive thumb screws in the 4105-XX front panel and remove the PANEL/CPU PCB assembly as far as is allowed the by the ribbon cable.
3. Unscrew the sensor harness from the transmitter (TB1).
4. Remove the three wires from the P,S,G terminals (TB2).
5. Remove the I/O PCB.
6. Reverse the preceding steps to install the new transmitter.
7. Restore power and allow a minimum of 30 minutes for stabilization before re-calibration.

6.4 Sensor Replacement

The sensor should be replaced when it is determined that:

- It is no longer possible to obtain correct Zero and Span values at the test points or at the controller.
- The sensor output signal is noisy, causing erroneous gas level readings.

To replace the sensor:

1. Remove the gas sensor module enclosure lid.
2. Remove the front panel by loosening the two captive thumb screws in the 4105-XX front panel and remove the PANEL/CPU PCB assembly as far as is allowed the by the ribbon cable.
3. Unscrew the sensor wires from the transmitter..
4. Unscrew the old sensor assembly from the enclosure conduit hub. Remove the sensor assembly with its harness.
5. Reverse the preceding steps to install the sensor assembly.

6.4a. Combustibles

1. Verify the voltage across A to R equals 2 volt. If not, adjust volts potentiometer R11
2. Verify the voltage from GND (TB2) to VOUT equals 0.4 volts. If not adjust BAL potentiometer (R2)
3. Verify that the voltage at VOUT is equal to the voltage desired.

- The VOUT test point on the I/O PCB has a range of 0.4-2 volts for 0-100% of the measurement range. Therefore, 0%=0.4 volts, 25%=0.8, 50%=1.2 volts, 75%=1.6 volts, 100%=2 volts.
- Selecting the jumper at JP1 assigns one of four different sensitivity ranges to the module. The JP1 positions are labeled 1, 2, 3 & 4. JP1 jumper set the coarse up scale SPAN values by affecting the gain of the analog circuit. JP1 is set correctly if an application of 50% of full scale reads between 1.0 & 1.4 volts on VOUT. Fine-tuning of these setting is done later by adjusting the 4105-02 magnetic control.

  JP1 gain values are as follows:
  JP1 with jumper in position 1 = GAIN = 51
  JP1 with jumper in position 2 = GAIN = 26
  JP1 with jumper in position 3 = GAIN = 12.5
  JP1 with jumper in position 4 = GAIN = 7
  JP1 with no jumper = GAIN = 1
- More than one jumper may be installed to allow additional gain value. Multiple jumper are additive in relation of the gain value. For example, if a gain of 20 is needed, jumper should be placed in positions 3 and 4 to provide a gain of 20.

6.4b LEL Sensor Fault Supervision

The typical failure mode of catalytic bead sensors is the reference or active beads open circuit. In rare cases a short circuit may develop. The 4105-02 is equipped with fault detection circuitry that detects either condition. A FAULT is also signaled if the output drifts below -10% of full scale. The 4105-02 signals a FAULT condition exists by overwriting the LCD with a FLt message, flashing the red LED on the front panel and clamping the 4-20mA output at 0mA. These conditions remain until the FAULT is corrected.

6.4c Electrochemical (Oxygen and Toxics)

Verify that the voltage VOUT is equal to the voltage as desired.

- The VOUT test point on the I/O PCB has a range of 0.4-2 volts for 0-100% of the measurement range.
- The 4105-XX has 4 fixed ranges of sensitivity, which are selectable via JP1.
- The JP1 positions are labeled 1, 2, 3 & 4.
- JP1 jumper set the coarse up scale SPAN values by affecting the gain of the analog circuit.
- JP1 is set correctly if a 50% of full-scale gas read between 1.0 & 1.4 volts on VOUT.
- Fine-tuning of these settings is done later by adjusting the 4105-XX via magnetic control.
- Select the jumper at JP1 as required. JP1 gain values are as follows:
  JP1 with jumper in position 1 = GAIN = 5.5
  JP1 with jumper in position 2 = GAIN = 4
  JP1 with jumper in position 3 = GAIN = 2.3
  JP1 with jumper in position 4 = GAIN = 1.5
  JP1 with no jumper = GAIN = 1
- More than one jumper may be installed to allow additional gain value. Multiple jumper are additive in relation of the gain value. For example, if a gain of 6.5 is needed, jumper should be placed in positions 2 and 3 to provide a gain of 6.3.

Note: Allow the new sensor to stabilize for a minimum of 30 minutes and then calibrate using the procedure in Section 5.

6.4d Missing Electromechanical Sensor Fault Supervision

Many electromechanical sensor housings allow for easy replacement of defective sensors by making the sensors 'plug in'. A problem is that if the sensor is removed, many transmitters continure to display the safe reading of 0 PPM. The 4105-XX is equipped with fault detection circuitry that detects a missing sensor. Within several minutes of removing an EC sensor, the 4105-XX will signal a FAULT condition. A FAULT is also detected if the sensor output drifts below -10% of full scale. the Model 4105-XX demonstrates a FAULT condition exists by overwriting the LCD reading with FLt, illuminating the red LED on the front panel and by clamping the 4-20mA output at 0mA. These conditions exist until the FAULT is corrected.

7. INSTALLATION

7.1 Sensor Locations

Select locations for each of the sensors based on the following:

- Consider the density of the gas to determine height of sensor above floor or ground level.
- Sensors should be placed close to the potential source of gas.
- Sensors should be placed in areas accessible for calibration.
- Sensors must be pointed down and the conduit should include an inverse trap to reduce moisture (condensation) from accumulating in the electronics enclosure. See Figure 7.1.

7.2 Sensor Mounting

Where possible sensor modules should be installed with the sensor facing vertically down. The lid of the sensor module should face out for easy access.

Sensors may be mounted directly onto the end of a vertical conduit, or bracketed to a vertical surface using the two mounting flanges. Insure that the body of the enclosure is at least 1" from the wall so that the sensor assembly can be rotated for removal and replacement. See Figure 6.1 for installation configurations.

7.3 Explosion Proof Installation

Where area classification requires explosion proof (NEMA-7) installation a sealing fitting will be required immediately above the gas sensor module enclosure.

7.4 Power Supply

The power supplied by the controlling device or an external power supply must meet the following specifications:

Voltage:	21-30 VDC
Current:	180 mA (Combustibles)
	40 mA (Oxygen & Toxics)

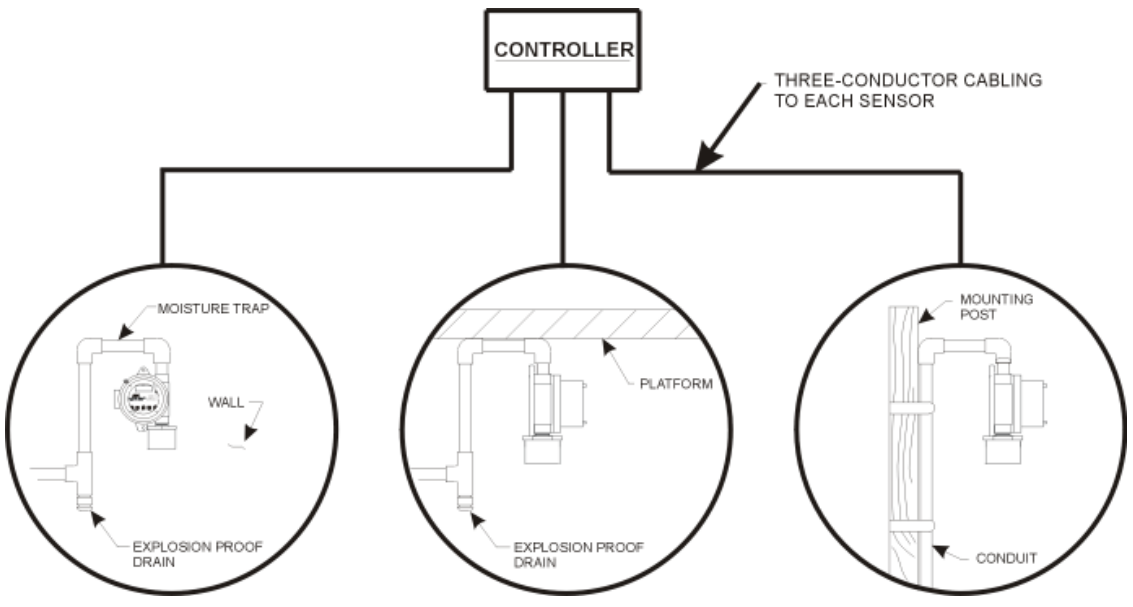


Figure 7.1
Gas Sensor Module Installation

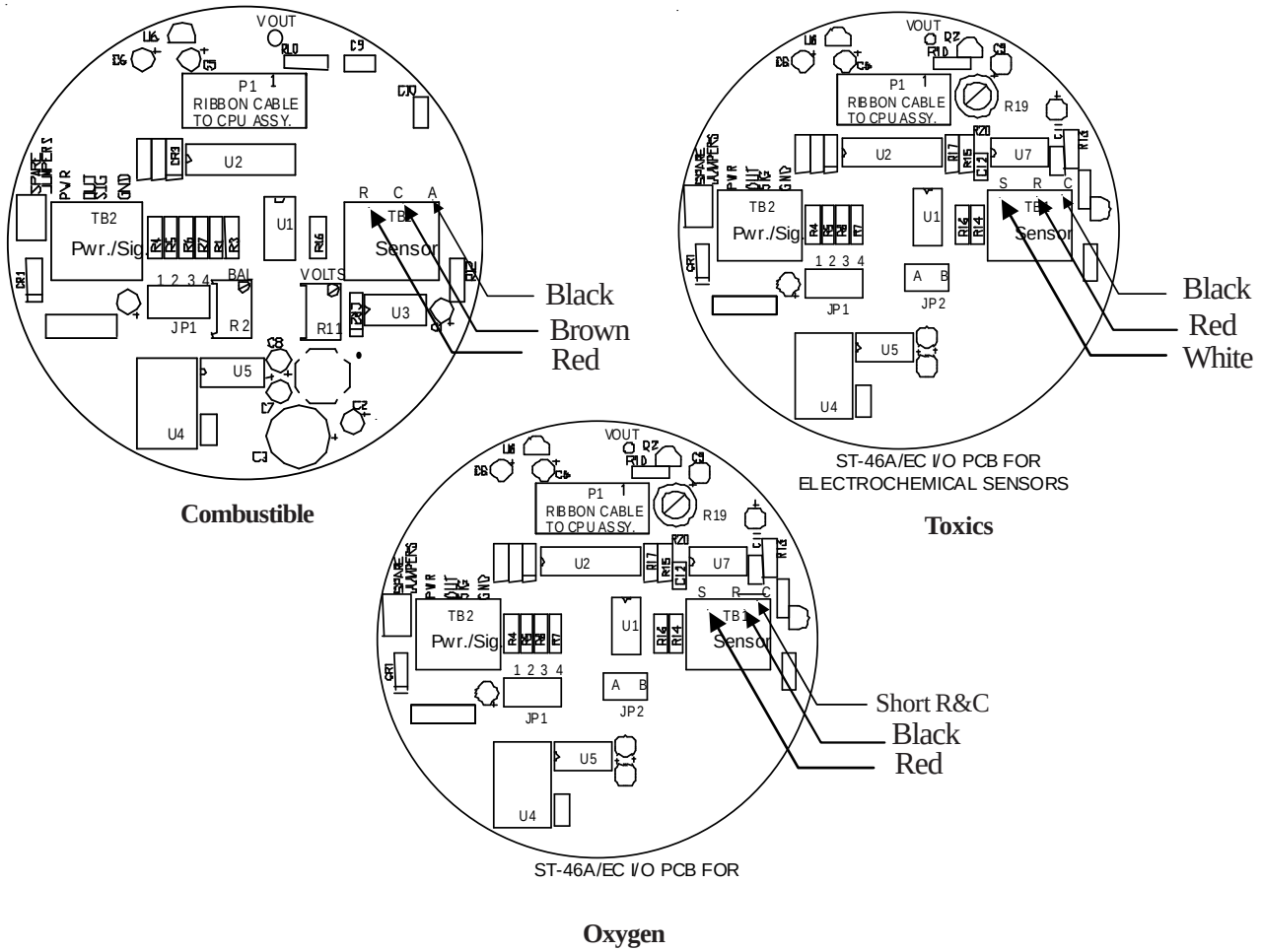


Figure 7.2
Wiring Diagram

8. SPECIFICATIONS

Model	4105-02	4105-03	4105-04	4105-05	4105-06	4105-07	4105-10
Gas	Comb.	O_2	CO	H_2S	Cl_2	H_2	SO_2
Sensor Type	Catalytic	E.C.	E.C.	E.C	E.C.	E.C.	E.C.
Units	%LEL	% Vol	ppm	ppm	ppm	ppm	ppm
Range	0-100	0-25%	0-1000	0-100	0-10	0-1000	0-100
Resolution	3% F.S.	0.1% F.S.	1	0.1	0.1	2	0.5
Response Time to 90% of signal	Note 1	10 sec.	25 sec.	30 sec.	60 sec.	30 sec.	20 sec.
Sensor Life [2]	3 Yrs	2 yrs	2 yrs	2 yrs	2 yrs	2 yrs	2 yrs
Operating Range							
Temperature	14 to 158°F -10 to 75°C	19 to 122°F -7 to 50°C	14 to 122°F -10 to 50°C	14 to 122°F -10 to 50°C	14 to 122°F -10 to 50°C	14 to 122°F -10 to 50°C	14 to 122°F -10 to 50°C
Relative Humidity	10-95%	5-99%	15-90%	15-90%	15-90%	10-90%	15-90%
Pressure	10%	10%	10%	10%	10%	10%	10%
Electrical Data							
Input Voltage DC	19-30VDC at less than 100 mA						
Output-Normal	4-20 mA DC linear						
Output-Trouble	0 mA						
Construction							
Dimensions	H: 7.6", D: 4.6", W: 4.2" (19.3 x 11.7 x 10.7 cm)						
Weight (Module)	5.0 lb. (2.2 kg)						
Mounting	3/4" NPT						
Housing	Explosion proof (NEMA 7) / NEMA 4X Enclosure (Div. I, Class 1, Groups B, C, D)						

Notes: 1. Step to 50% LEL within 10 sec, recovery to 10% LEL within 30 sec.

2. Sensor life is for use at standard temperature and pressure with occasional exposure to the gas of interest

8. SPECIFICATIONS (Continued)

Model	**4105-12**	**4105-21**	**4105-22**	**4105-25[3]**	**4105-26[3]**
Gas	NO_2	HCL	HCN	NH_3	HF
Sensor Type	E.C.	E.C.	E.C.	E.C.	E.C.
Units	ppm	ppm	ppm	ppm	ppm
Range	0-20	0-20	0-20	0-50	0-10
Resolution	0.2	0.5	0.1	0.1	0.5
Response Time to 90% of signal	35 sec.	150 sec	70 sec.	45 sec.	30 sec.
Sensor Life [2]	2 yrs	2 yrs	2 yrs	N/A	N/A
Operating Range					
Temperature	14 to 122°F -10 to 50°C	14 to 122°F -10 to 50°C	14 to 122°F -10 to 50°C	14 to 113°F -10 to 45°C	14 to 113°F -10 to 45°C
Relative Humidity	15-90%	15-90%	15-90%	20-90%	20-90%
Pressure	10%	10%	10%	10%	10%
Electrical Data					
Input Voltage DC	19-30 VDC at less than 100 mA				
Output-Normal	4-20 mA DC linear				
Output-Trouble	0 mA				
Construction					
Dimensions	H: 7.6", D: 4.6", W: 4.2" (19.3 x 11.7 x 10.7 cm)				
Weight (Module)	5.0 lb. (2.2 kg)				
Mounting	3/4" NPT				
Housing	Explosion proof (NEMA 7) / NEMA 4X Enclosure (Div. I, Class 1, Groups B, C, D)				

Notes: 2. Sensor life is for use at standard temperature and pressure with occasional exposure to the gas of interest

3. Diffusion via membrane. Dimensions are H: 10.2", D: 6.0", W: 6.0" (25.9 x 15.2x 15.2 cm)

8. SPECIFICATIONS (Cont.)

Cross Sensitivities (toxic sensors)

Model Number	Gas Type	Reading from 100 ppm of interfering gas									
		CO	H_2S	Cl_2	H_2	SO_2	NO_2	NO	HCl	HCN	C_2H_4
4105-04	CO	100	315	-15	<40	50	-55	30	2	40	<50
4105-05	H_2S	<0.5	100	-20	<0.1	<15	-15	0	0	0	0
4105-06	Cl_2	0	<-10	100	0	0	105	0	0	0	0
4105-07	H_2	<1	<20	0	100	3	0	35	3	35	85
4105-10	SO_2	<1	0	-40	0	100	-100	0	0	15	0
4105-12	NO_2	0	-20	90	0	0	100	0	0	-3	0
4105-21	HCl	0	75	-10	0	35	-2	0	100	-8	0
4105-22	HCN	<0.5		-50	0	160	-190	-5	30	100	<1
4105-25	NH_3	0	0	0	-	40	0	0	-	-	-
4105-26	HF	0	0	9	0	9	5	-	6	-	-

9. REPLACEMENT PARTS

4205-02	Sensor Assembly, Combustible, Non-Intrusive
4205-03	Sensor Assembly, 4-20 mA O_2, Non-Intrusive
4207-04	Sensor Assembly, 4-20 mA CO, Non-Intrusive
4205-05	Sensor Assembly, 4-20 mA H_2S, Non-Intrusive
4205-06	Sensor Assembly, 4-20 mA Cl_2, Non-Intrusive
4207-07	Sensor Assembly, 4-20 mA H_2, Non-Intrusive
4207-10	Sensor Assembly, 4-20 mA SO_2, Non-Intrusive
4207-12	Sensor Assembly, 4-20 mA NO_2, Non-Intrusive
4207-21	Sensor Assembly, 4-20 mA HCl, Non-Intrusive
4207-22	Sensor Assembly, 4-20 mA HCN, Non-Intrusive
4207-25	Sensor Assembly, 4-20 mA NH_3, Non-Intrusive
4207-26	Sensor Assembly, 4-20 mA HF, Non-Intrusive
5311-00	Rainshield

10. LIMITED WARRANTY

SIERRA MONITOR CORPORATION warrants its products to be free from defects in workmanship or material under normal use and service for two years after date of shipment. SMC will repair or replace without charge any equipment found to be defective during the warranty period. Final determination of the nature and responsibility for defective or damaged equipment will be made by SMC personnel.

All warranties hereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without SMC approval or which have been subjected to accident, improper maintenance, installation or application, or on which original identification marks have been removed or altered. This Limited Warranty also will not apply to interconnecting cables or wires, consumables (ie. calibration gases, batteries, sensors), nor to any damage resulting from battery leakage.

In all cases SMC's responsibility and liability under this warranty shall be limited to the cost of the equipment. The purchaser must obtain shipping instructions for the prepaid return of any item under this warranty provision and compliance with such instruction shall be a condition of this warranty.

Except for the express warranty stated above, SMC disclaims all warranties with regard to the products sold hereunder including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of SMC for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.

Appendix A: Unity Gain Mode

The Unity magnetic control is available during CAL MODE to allow the ZERO and SPAN adjustments to be centered within their range. This is similar to setting a potentiometer so the wiper terminal is exactly halfway between the clockwise and counterclockwise terminals. this is identified as the UNITY GAIN mode. In UNITY GAIN the ZERO controls have a ± 15% of full scale adjustment range. For example, in UNITY GAIN, if the sensor's ZERO output has drifted so high that it reads 15% with ZERO gas applied, the DOWN ZERO magnetic control could still bring the 4105-XX reading to ZERO. However, it will be at the end of its adjustment range. If the ZERO adjustment required is greater than ±10% of full scale, a BALANCE adjustment should be performed as described in Appendix A.

In UNITY GAIN the SPAN controls have a .5 to 2 adjustment range. For example, in UNITY GAIN, if a sensor's output sensitivity has been reduced to the point where 50% SPAN gas provides only a 25% reading, the UP SPAN magnetic control could still calibrate the reading to the proper value of 50%. However, it will be at the end of its adjustment range.

Appendix B: L.C.D. Readout Calibration Procedure

The 3 1/2 digit LCD meter span and decimal points may be configured for full scale ranges such as 1-100, 0-25, 0-10.0, 0-1000 and many others. Zero percent of full-scale readings, or those corresponding to 4mA, are always assumed to equal a reading of 0. Holding the magnet over the CAL key for at least 5 seconds enters the LCD METER SPAN SETUP MODE. After this, the current setting for 100% full scale is displayed and may be modified using the UP/DOWN SPAN keys. This sets the LCD reading displayed when the 4-20mA output equals 30mA. Decimal points are added with the UNITY key.

Appendix C: End of Sensor Life Indication

Old sensors near the end of their service life require higher gain settings. M4105-XX "END OF SENSOR LIFE" (ESL) feature may be used to indicate condition. A span trip point may be entered that when exceeded, causes the LCD to flash and ESL reading for 2-seconds each 10 seconds. Holding the magnet to the UNITY key for at least 5 seconds brings the LCD a span value set-point reading for setting when the ESL indication trips. CAL MODE GAIN adjustments range between .5 and 2 and the ESL set-point is adjustable between 1.5 and 2.01 with 2.01 turning the ESL feature off. The current span setting may be viewed on the LCD during NORMAL MODE by touching the DOWN SPAN key.

Appendix C: Combustible Gas Scaling Factors (Table 1)

Where possible, calibration gas should be the same as the gas to be detected. If this is not possible then a scaling factor should be used to determine the "equivalent value" of the calibration gas in terms of the gas to be detected. (Note: Concentration of calibration gas must be less than the factor number listed on Table 1).

The formula for calibration is as follows:

Display = (Cal gas) / Factor

where: Display = the span gas applied
Cal gas is the percent methane used for calibration.
Factor is a number that corresponds to the gas to be measured. (see Table 1)

Example: The application is for measurement of Propane and Methane is the calibration gas.

The factor for Propane (from Table 1) is 55.

For the example, calibration gas is Methane at 40% LEL.

Display = 40% LEL Methane / 55 = 0.73

Display = Adjust span until LCD reads 73.

COMBUSTIBLE GAS SCALING FACTORS

For combustible gas monitoring, a calibration standard of Methane or Propane my be used in conjunction with scaling factors to cause alarm function in %LEL scale of another gas as follows:

GAS	METHANE FACTOR	PROPANE FACTOR
Acetaldehyde	60	109
Acetic Acid	54	98
Acetic Anhydride	46	83
Acetone	52	94
Acetylene	57	103
Alkyl Alcohol	51	92
Ammonia	126	229
n-Amyl Alcohol	33	59
Aniline	39	71
Benzene	41	74
Biphenyl	25	45
1,3-Butadiene	56	101
n-Butane	58	106
iso-Butane	52	94
Butene-1	45	82
cis-Butene-2	48	88
trans-Butene-2	51	92
n-Butyl Alcohol	34	62
iso-Butyl Alcohol	53	96
tert-Butyl-Alcohol	74	134
n-Butyl Benzene	31	57
iso-Butyl Benzene	32	58
n-Butyric Acid	38	69
Carbon Disulfide	18	32
Carbon Monoxide	75	137
Carbon Oxysulphide	93	169
Chlorobenzene	34	62
Cyanogen	89	162
Cyclohexane	41	74
Cyclopropane	62	113
n-Decane	33	59
Diethylamine	49	88
Dimethylamine	58	105
2,3-Dimethylpentane	40	72
2,3-Dimethylpropane	40	72
Dimethylsulphide	43	79
1,4-Dioxane	45	81
Epichlorohydrin	45	82
Ethane	68	123
Ethyl Acetate	51	93
Ethyl Alcohol	73	132
Ethylamine	53	95
Ethyl Benzene	36	65
Ethyl Bromide	91	165
Ethyl Chloride	57	103
Ethylcyclopentane	40	72
Ethylene	71	128
Ethylenedichloride	66	120
Ethyleneoxide	52	94

GAS	METHANE FACTOR	PROPANE FACTOR
Diethyl Ether	46	84
Dimethoxyethane	42	75
Dimethyl Ether	63	113
Dimethylformamide	46	83
Ethyl Formate	44	80
Ethylmercaptan	56	102
n-Heptane	39	70
n-Hexane	37	67
Hydrazine	45	82
Hydrogencyanide	48	86
Hydrogen	77	139
Hydrogen Sulfide	41	74
Methane	100	181
Methyl Actetate	50	90
Methyl Alcohol	86	156
Methylamine	77	140
Methyl Bromide	90	162
Methyl Chloride	102	186
Methylcyclohexane	44	80
Methylenedichloride	93	168
Methylethylether	44	80
Methylethylketone	41	75
Methyl Formate	67	121
Methylmercaptan	61	110
Methylpropionate	51	93
Methyl n-propylketone	40	73
Napthalene	34	62
Nitromethane	34	62
n-Nonane	31	57
n-Octane	37	68
n-Pentane	46	83
i-Pentane	46	84
Propane	55	100
n-Propyl Alcohol	47	85
n-Propylamine	48	88
n-Propylchloride	50	90
Propylene	52	93
Propyleneoxide	46	83
iso-Propylether	44	79
Propyne	42	75
Toluene	40	73
Triethylamine	40	72
Trimethylamine	48	88
Vinylethylether	42	76
o-Xylene	36	65
m-Xylene	39	71
p-Xylene	39	71
JP-4 (Jet Fuel)	41	73

NOTES:

1. Scaling factors are not FMRC approved.
2. Base data source: EEV sensor specification catalog. (EEV claims some data is the result of specific tests, other data is empirically derived.)
3. Display = Cal Gas / Factor = % LEL
   => must be less than 1

TABLE 1
COMBUSTIBLE GAS SCALING FACTORS